

#### REMARKS

Reconsideration is respectfully requested in view of the following remarks.

Independent claim 1 has been amended to include all of the subject matter of claims 2 and 5 except that the total porosity range of manganese dioxide based on pores within the manganese dioxide, has been slightly broadened from between  $0.035 \text{ cm}^3/\text{g}$  and  $0.050 \text{ cm}^3/\text{g}$  as recited in claim 2 to the new range between **" $0.035 \text{ cm}^3/\text{g}$  and  $0.060 \text{ cm}^3/\text{g}$ ."** The range of said total porosity between " $0.035 \text{ cm}^3/\text{g}$  and  $0.060 \text{ cm}^3/\text{g}$ " finds clear support in the specification at pp. 28 and 29 in the context of the remaining three parameters defining the manganese dioxide as set forth in amended claim 1. For example, it is stated in Applicants' specification at p. 28, lines 21 to p.29, line 5:

"It will be observed from the data presented in the tables that manganese dioxide produced by such conventional processes do not have the combination of BET surface area and micropore area at total porosity between  $0.035 \text{ cm}^3/\text{g}$  and  $0.06 \text{ cm}^3/\text{g}$  which Applicant has determined can result in a manganese dioxide having a meso-macro pore average radius greater than 32 Angstrom. Specifically, an analysis of the data reported in the accompanying tables reveals that none of the prior art conventional battery grade manganese dioxide, whether produced by conventional electrolysis (EMD) or by conventional chemical processing (CMD), results in a manganese dioxide product having the combination of BET surface area between 20 and  $31 \text{ m}^2/\text{g}$  simultaneously with and micropore area between about 8 and  $13 \text{ m}^2/\text{g}$ , within the context of a total intraparticle porosity of between about  $0.035$  and  $0.06 \text{ cm}^3/\text{g}$ , more typically between about  $0.035$  and  $0.05 \text{ cm}^3/\text{g}$ ."

Independent claim 6 has been amended to include all of the subject matter of dependent claim 7 and 9. Accordingly, claims 7 and 9 have been canceled.

Independent claim 10 has been amended to include all of the subject matter of claims 11 and 13. Accordingly, claim 11 and 13 have been canceled.

Independent claim 14 has been amended to include all of the subject matter of claims 15 and 17. Accordingly claims 15 and 17 have been canceled.

#### Arguments Against the Rejection Under 35 USC 103 (a)

Claims 1-17 have been rejected under 35 USC 103(a) as being unpatentable over Takehara et al. (U.S. 5,746,902).

Applicant's invention is directed to production of a novel particulate  $\text{MnO}_2$ , having simultaneously a micropore surface area between about 8.0 and 13  $\text{m}^2/\text{g}$  and BET surface area of between about 20 and 31  $\text{m}^2/\text{g}$  wherein the average meso-macro pore radius is greater than 32 Angstrom. In particular Applicant's invention is directed to production of a novel particulate  $\text{MnO}_2$ , having simultaneously a micropore surface area between about 8.0 and 13  $\text{m}^2/\text{g}$  and BET surface area of between about 20 and 31  $\text{m}^2/\text{g}$  wherein the average meso-macro pore radius is greater than 32 Angstrom in combination with a total porosity of between 0.035 and 0.06  $\text{cm}^3/\text{g}$ . Micropores are defined as intraparticle pores (pores within the particles) having pore size less than or equal to 20 Angstrom and meso-macropores are defined herein as meso plus macro pores, that is, all other intraparticle pores having

a diameter greater than 20 Angstrom. Applicant has determined that such  $\text{MnO}_2$  product will produce enhanced performance when employed as cathode active material in an electrochemical cell, particularly an alkaline cell. In particular such particulate  $\text{MnO}_2$  product further having the additional property of a total intraparticle porosity (micropores plus meso-macro pores) of between about  $0.035 \text{ cm}^3/\text{g}$  and  $0.06 \text{ cm}^3/\text{g}$ , results in a very desirably  $\text{MnO}_2$  exhibiting enhanced performance when employed as cathode active material in an alkaline cell.

The reference Takehara (U.S. 5,746,902) deals with production of particulate  $\text{MnO}_2$  which has a BET surface area of less than  $30 \text{ m}^2/\text{g}$  and a "suspensiveness" property (as determined and defined by Takehara at col. 4, lines 1-40) of less than 50 mg/liter. Briefly, the suspensiveness property which Takehara characterizes is the amount (mg/liter) of a given 10 gram sample of  $\text{MnO}_2$  (EMD) powder which can be suspended in a strong KOH solution at 80 deg for 12 hours in accordance with a defined procedure. Takehara reports that an  $\text{MnO}_2$  sample having a suspensiveness of less than 50 mg/liter together with a BET surface area of less than  $30 \text{ m}^2/\text{g}$  tends to give better battery life. There is no concern or mention in Takehara of production of Applicant's claimed  $\text{MnO}_2$  having simultaneously a BET surface area between about 20 and  $31 \text{ m}^2/\text{g}$ , a micropore surface area between about 8 and  $13 \text{ m}^2/\text{g}$  and average meso-macro pore radius greater than 32 Angstrom, together with a total porosity between  $0.035$  and  $0.060 \text{ cm}^3/\text{g}$ . In fact Takehara does not even mention micropores or micropore surface area or any intent to keep such micropore area within any range, nor is Takehara concerned with average meso-macro pore radius in his particulate  $\text{MnO}_2$  product. There is no link expressed or implied in Takehara between his "suspensiveness" property and Applicant's micropore area or

total porosity. In essence, micropores, measurement of micropores or porosity is nowhere mentioned in Takehara.

Applicant's method of producing particulate  $\text{MnO}_2$  having the above combined properties is achieved by electrolysis conducted under novel conditions not disclosed or suggested by others in the art. For example, Applicant's product is made by electrolysis of a bath of manganese sulfate and sulfuric acid conducted at elevated temperatures, for example, between  $120^\circ \text{C}$  and  $155^\circ \text{C}$  and at elevated pressure in combination with specific levels of current density, for example, between about 6 and 10  $\text{Amp/ft}^2$  (64.6 and 107.6  $\text{Amp/m}^2$ ). Such combination of electrolysis conditions are illustrated in Applicant's examples at p. 23 of the specification as filed. (Aspects of the process are also discussed in Applicant's commonly assigned issued patent Davis, U.S. 6,585,881 B2.)

By contrast the principal reference Takehara (U.S. 5,746,902) discusses  $\text{MnO}_2$  particle properties wherein the  $\text{MnO}_2$  was made by electrolysis conducted at temperatures in a range between  $93^\circ \text{C}$  to  $103^\circ \text{C}$ . There is no suggestion in Takehara of conducting the electrolysis within Applicant's advantageous elevated temperature, for example, between  $120^\circ \text{C}$  and  $155^\circ \text{C}$ . Moreover, Takehara discloses a suspension method for making the  $\text{MnO}_2$ , wherein manganese oxide is suspended in an electrolysis bath containing sulfuric acid and electrolyzed at electrolytic temperatures between  $93^\circ \text{C}$  and  $103^\circ \text{C}$  at anodic current densities between about 0.4 and 3.0  $\text{Amp/dm}^2$  (40 and 300  $\text{Amp/m}^2$ ). The processes described in Applicant's invention leading to Applicant's  $\text{MnO}_2$  product is thus different from the processes described in Takehara, for example, since Takehara does not carry out his electrolysis at Applicant's elevated temperatures.

Clearly Takahara is focused on producing an  $\text{MnO}_2$  having very specific properties and is not focused on producing Applicant's particulate  $\text{MnO}_2$  with Applicant's claimed properties, namely, simultaneously a micropore surface area between about 8.0 and 13  $\text{m}^2/\text{g}$ , a BET surface area of between about 20 and 31  $\text{m}^2/\text{g}$ , an average meso-macro pore radius greater than 32 Angstrom within the context of said  $\text{MnO}_2$  also having a total intraparticle porosity of between about 0.035  $\text{cm}^3/\text{g}$  and 0.060  $\text{cm}^3/\text{g}$ . There is nothing in Takehara to indicate a particulate  $\text{MnO}_2$  having such combination of properties, or any advantage to be derived therefrom, is contemplated. Since Applicant's electrolysis process and conditions of operation are very much different from Takehara's there is no basis for any argument that Takehara's  $\text{MnO}_2$  product would inherently have the same properties as Applicant's product.

Applicant has determined that it is desirable to produce a particulate  $\text{MnO}_2$  wherein the average radius of the meso-macropores within the  $\text{MnO}_2$  particles are large, namely, greater than 32 Angstrom. Applicant believes that such large radius of the meso-macropores facilitate excellent ionic conduction of water and electrolyte hydroxyl ( $\text{OH}^-$ ) ions. It has been determined that the higher meso-macropore average radius together with high micropore surface area between about 8 and 13  $\text{m}^2/\text{g}$  in combination with a total porosity between 0.035 and 0.060  $\text{cm}^3/\text{g}$  helps to achieve the excellent performance of the  $\text{MnO}_2$  of the invention as cathode active material in alkaline cells. The micropores (micropore surface area between 8.0 and 13  $\text{m}^2/\text{g}$ ) within the individual  $\text{MnO}_2$  particles are believed responsible for or greatly facilitate attainment of high voltage, high rate and high capacity cell performance. This is due to the presence of a high level of surface water and bound protons ( $\text{H}^+$  ions) within

the micropores. Takehara does not contemplate an  $\text{MnO}_2$  product having such combination of properties or any method of making such product.

Applicant has amended claim 1 to include the subject matter of claim 2 and 5 except that the total porosity of manganese dioxide based on pores within the manganese dioxide has been ly broadened from between  $0.035 \text{ cm}^3/\text{g}$  and  $0.050 \text{ cm}^3/\text{g}$  as recited in claim 2 to the broadened range between " $0.035 \text{ cm}^3/\text{g}$  and **0.060**"  $\text{cm}^3/\text{g}$ ." The slightly broadened range of said total porosity between " $0.035 \text{ cm}^3/\text{g}$  and **0.060**"  $\text{cm}^3/\text{g}$  finds clear support in the specification as above referenced, for example, at pp. 28, line 21 to p.29, line 5.

Thus claim 1 now recites an  $\text{MnO}_2$  product having simultaneously a BET surface area between about 20 and  $31 \text{ m}^2/\text{g}$ , a micropore area between about 8 and  $13 \text{ m}^2/\text{g}$  and an average meso-macro pore radius greater than 32 Angstrom, and a total porosity based on pores within the manganese dioxide of between  $0.035 \text{ cm}^3/\text{g}$  and  $0.060 \text{ cm}^3/\text{g}$ . Amended claim 1 also recites, for clarity, that the micropores therein are defined as intraparticle pores having a diameter less than or equal to 20 Angstrom and the meso-macropores are intra particle pores having a diameter greater than 20 Angstrom. Of all the limitations recited in Applicant's amended claim 1 Takehara discloses only a BET surface area which is within Applicant's range. Namely, Takehara discloses a manganese dioxide having a BET specific surface area of less than  $30 \text{ m}^2/\text{g}$ , preferably less than  $27 \text{ m}^2/\text{g}$  which is within Applicant's range of between 20 and  $31 \text{ m}^2/\text{g}$ . However, Takehara is not concerned with and does not disclose any micropores and certainly does not disclose Applicant's specific size micropore between 8 and  $13 \text{ m}^2/\text{g}$ . Similarly,

Takehara does not disclose presence of meso-macro pore radius greater than 32 Angstrom. And finally Takehara does not disclose a manganese dioxide with total porosity within Applicant's claimed range of between 0.035 and 0.060 cm<sup>3</sup>/g. More importantly Takehara does not disclose a manganese dioxide having simultaneously all of the properties recited in independent claim 1. Nor is there any evidence or suggestion in Takehara that such combination of properties simultaneously is achievable by any conventional methods of producing manganese dioxide under conventional electrolysis conditions or by the suspension method described in this reference.

The Examiner makes reference to Takehara's recitation of average manganese dioxide particle size between 20 and 46 microns (col. 4, lines 53-56). Applicant's particle size as discussed in the specification can be over a broad range between 1 and 100 micron, desirably between 10 and 50 micron. But particle size has nothing to do with predicting or suggesting Applicant's claimed combination of properties. That is, there is effectively, no relationship between particle size, per se, and total intraparticle porosity or micropore surface area. This is because as Applicant has indicated, over 99% of the manganese dioxide surface is internal. (Applicant's specification at p. 7, line 31 to p. 8, line 3.) This is particularly true for the micropores within the manganese dioxide particle. So changing particle size of a given manganese dioxide will not noticeably change the BET surface area, micropore area or total porosity. Thus, Takehara cannot render obvious Applicant's independent claim 1, since Takehara does not disclose or suggest a manganese dioxide having Applicant's claimed combination of properties. In fact Takehara is not concerned with and does not mention micropores anywhere in his disclosure, let alone Applicant's

specific range for micropore area between 8 and 13 m<sup>2</sup>/g in combination with a total porosity of between 0.035 cm<sup>3</sup>/g and 0.060 cm<sup>3</sup>/g further in combination with a BET surface of between 20 and 31 m<sup>2</sup>/g. There is no link between Takehara's disclosure and Applicant's claimed combination of elements. The rejection of claim 1 under 35 USC 103 in view of Takehara is believed traversed and withdrawal of the rejection of claim 1 as amended is requested.

Independent claim 6 recites a particulate electrolytic manganese dioxide having similar simultaneous combination of limitations as independent claim 1, except that total porosity is between 0.035 and 0.040 cm<sup>3</sup>/g. Independent claim 10 recites a particulate electrolytic manganese dioxide having similar simultaneous combination of limitations as independent claim 1 except that total porosity is between 0.040 and 0.045 cm<sup>3</sup>/g.. Independent claim 14 recites a particulate electrolytic manganese dioxide having similar simultaneous combination of limitations as independent claim 1 except that total porosity is between 0.045 and 0.050 cm<sup>3</sup>/g. Thus, the same arguments for patentability as made for independent claim 1 apply as well to independent claims 6, 10, and 14. Namely, Takehara does not disclose or suggest a manganese dioxide having simultaneously all of the properties recited in independent claim 1. There is no evidence or suggestion in Takehara that Applicant's combination of properties as recited in independent claim 6, 10 and 14 is achievable by conventional electrolysis methods or by Takehara's suspension method. Thus, Takehara cannot render obvious Applicant's independent claims 6, 10, and 14. The rejection of independent claims 6, 10 and 14 under 35 USC 103 in view of Takehara is believed traversed and withdrawal of the rejection of these claims as amended is requested.



The remaining dependent claims of record reflect specific embodiments of the invention and further restrict the scope of the independent claims from which they depend. These claims thus should be allowed if the independent claims are deemed allowable.

#### Double Patenting Rejection

The Examiner has rejected claims 1-17 under the judicially created doctrine of obviousness type double patenting as being unpatentable over claims of the U.S. patent 6,863,876. The present application Ser. 10/724,495 is a commonly assigned continuation in part of application Ser. No. 10/094199 filed March 8, 2002, which has issued as U.S. 6,863,876.

In order to overcome the Double Patenting rejection Applicant submits herewith a copy of the recorded Assignments (Exhibit 1) for parent application Ser. 10/094199, now U.S. patent 6,863,876 and a copy of the recorded Assignment (Exhibit 2) for the subject CIP application Ser. 10/724495. The Assignee in each case is The Gillette Company. The required Terminal Disclaimer is also submitted herewith. Accordingly, the double patenting rejection is believed traversed and withdrawal of the rejection is requested.

Every effort has been made to place the application in condition for allowance. A favorable action by the Examiner and a formal allowance is solicited.

The undersigned attorney solicits a telephone call from the Examiner to clarify any questions which the Examiner may have concerning the application. Authorization is hereby given to debit Deposit Account 502271 for any amount owing or credit the

same account for any overcharges in connection with this communication.

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Respectfully submitted,



Barry D. Josephs  
Attorney At Law  
19 North St.  
Salem, Mass. 01970

Barry D. Josephs  
Reg. No. 27,140  
Tel. (978) 741-7999

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I certify that this correspondence is being deposited with the United States Postal Service as first class mail with sufficient postage in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on April 6, 2005.

  
Barry D. Josephs